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Veterinary Department.

DR. F. S. SCHOENLEBER, *Veterinarian in Charge*.

FIG. II.

Hog Cholera and Vaccination.

BY

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HOG CHOLERA AND VACCINATION.

In many sections of the state of Kansas hogs would be the most profitable of all crops if it were not for the ravages of hog cholera. The value of this crop would be increased several hundred thousand dollars per year in the state if the cholera could be kept in check, and the Kansas State Agricultural College has undertaken this task through the production and distribution of anti-hog-cholera serum. During the year 1910 the college expects to produce upwards of 2,000,000 cc. (cubic centimeters) of the serum, or over 100,000 doses. A considerable of this serum has already been produced and thoroughly tested both at the college and in private herds. These results warrant the above statements. The first serum that was produced at the college was tested by the veterinarians with a representative of the United States Department of Agriculture. It was done as follows:

Six susceptible shotes (pigs which would take the cholera very easily) were used, each weighing about forty pounds. They were each given two cubic centimeters of virulent blood, injected into the muscles of the thigh. (Virulent blood is blood filled with the germs of hog cholera and is taken from a hog almost ready to die with the disease.) Two of these pigs were each given in addition to this blood a full dose (20 cc.) of the anti-hog-cholera serum.

Two more were given only three-quarters of the regular dose of serum (15 cc.). These pigs were all of about the same age, size and condition, and were all kept in the same pen, fed and cared for alike.

The results were as follows: The two which received the virulent blood only promptly died with acute hog cholera as shown upon *post-mortem* examination. The one died on the sixth day and the other on the seventh day after the injections were made. The remaining four, the ones which received a dose of the serum in addition to the virulent blood never lost a feed and have remained well and hearty since.

This showed that when the serum was given in only three-

quarters of a full dose it protected the pig against the cholera, *showing that the serum was highly potent.*

Before any serum produced at the Kansas State Agricultural College is sent out or used, it must be tested in the same way; it must prove, as the first did, that it will prevent the vaccinated hog from taking the cholera—it must prove potent.

FIG. I. Some of the buildings used in the production of anti-hog cholera serum at the Kansas State Agricultural College.

NATURAL IMMUNITY AND SUSCEPTIBILITY. During an outbreak of hog cholera there are usually a few hogs in the herd which do not show any signs of being sick. We say these hogs are naturally immune—that is, they either have only a very slight attack of the disease or they do not take the disease at all. After a hog has recovered from an attack of the cholera, it is also immune and will not take the disease the second time. Some of the herd take the disease and die in a few days; these we say are more susceptible—that is, they take it much more readily. A strong, healthy hog is considerably less susceptible than one which has been neglected in the way of feed or care. One peculiarity, however, is that quite fat and pampered hogs seem more susceptible than those in ordinary feeding or growing condition. *In either case the vitality has been reduced.*

ARTIFICIAL IMMUNITY AND VACCINATION. A hog can be made immune by vaccinating with anti-hog-cholera serum, so he will not take the disease. This is called artificial immunity and may last for a few weeks only, or during the life of the animal, according to the method used in vaccination. A very

young pig, however, may outgrow this artificial immunity and require to be revaccinated, on the same principle as the human being is revaccinated against smallpox at variable periods of time.

Figure 1 shows a number of the buildings used at the Agricultural College for the production of the serum. The larger building is used for the laboratories, the medium-sized one for a bleeding-house (8 by 10 ft.), and the smaller ones for the pigs which furnish the virulent blood. The small houses are stood over a water-tight trough, which is filled with antiseptic solution so that all of the germs in the seepage from the pens are caught in this trough and killed in this solution. (These houses are 4 by 6 feet, and usually contain four diseased pigs.) After each lot of pigs are removed the houses are thoroughly disinfected and all straw and litter burned to prevent the spread of the disease.

Figures III and IV show the inside of the laboratories and figure VII shows the inside of the bleeding-house where the blood is drawn which furnishes the serum. This process requires great care and cleanliness. The hog is first covered with a sterile cloth to prevent any dirt or germs from dropping into the vessel which collects the blood as it is drawn from the animal. The tail is shaved closely, then thoroughly sterilized with a strong antiseptic solution before each bleeding. The blood is immediately taken to the laboratory and defibrinated, leaving only the fluid part of the blood, which we call the serum. To this serum is added a small amount of a weak solution of carbolic acid to partially preserve it. It is then stored in a cool place until tested on some pigs, when, if it proves potent, it is ready for use.

HOW SERUM IS PRODUCED. Before the hog is ready to be bled for this serum it must first undergo the process of hyperimmunization—that is, his blood must be brought into a condition so that when it is drawn and injected into other hogs it will prevent them from taking the cholera. For this process one is taken which is immune to cholera—that is, it has either recovered from a case of cholera or has been vaccinated against the disease, and will therefore not take the disease again. Into this animal is injected, through the veins of the ear usually, five cubic centimeters of virulent blood for each pound of weight of the hog; for instance, a 200-pound hog receives

1000 cc. of virulent blood. After ten days the hog is ready to produce blood for serum and is bled usually three times more at intervals of seven days, and if the tail holds out he is then rehyperimmunized and again bled two or three times, the same as before. In either case at the last bleeding the hog is killed and all of his blood taken. The serum from all of these drawings is mixed together and its potency tested. If it is potent, it is ready for use. This is necessary as the serum from the last drawing is usually less potent than that from the first drawings, and after it is all mixed together it should be a serum of average potency.

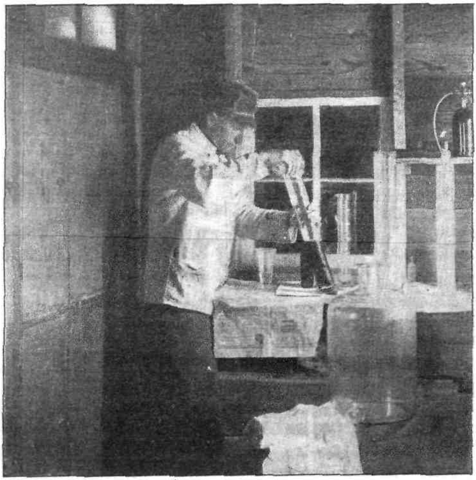

FIG. III. Serum laboratory. Mixing the serum.

The amount of serum produced from each drawing varies with the size of the hog, with his condition, the character of the weather and the manner in which the animal has been fed and cared for. A 200-pound hog will produce usually 600 cc. of serum at each bleeding, or a total of 3000 cc.—the last bleeding when killed usually yields 1200 cc. of serum.

It takes much practice and patience to inject such a large quantity of blood into the ear vein and also to draw such a large quantity from the tail of the hog. All of these operations must be done with thoroughly antiseptic precautions, to produce potent serum and to prevent injury to the pig itself or accidents to the serum.

To produce virulent blood enough to hyperimmunize a 200-pound hog requires three or four pigs weighing about forty pounds. They must be given a severe form of the disease and must be ready to kill at, or near, a certain time, as the virulent blood must be used for this work within a few hours after drawing. Again, in testing the serum it is necessary to use several more pigs. These are not all a total loss as it is usually possible to save their blood by killing them when they are about to die with the disease. Here again is the knowledge of the expert required. If the pig is killed too soon, the blood is not virulent enough for use, and if allowed to go too long before killing, the pig is liable to die and the blood cannot then be used at all. In order to produce this 3000 cc. of serum it requires one 200-pound hog and about five smaller pigs. This amount of serum will vaccinate about 150 hogs, so that for every 6 pigs sacrificed the lives of 150 are saved, or one pig for 25 (4 per cent).

EXPERTS NECESSARY TO PRODUCE THIS SERUM. Two expert graduate veterinarians with several high-grade helpers are now devoting their whole time to the production of this serum under the direction of the head of the veterinary department. This high-grade help is necessary; it reduces the danger of producing poor serum and also reduces the cost to a minimum as poor serum cannot be used at all.

COST OF THE SERUM AND SIZE OF THE DOSE. After the serum has been tested and found to be potent, it is put up in bottles of three sizes, sealed, and stored in a cement cellar where it can be kept at an even temperature until sent out for use. The small-sized bottle holds 100 cc., or enough serum to vaccinate five shotes weighing from 30 up to 100 pounds. The dose for this size animal is 20 cc. The larger bottles hold 500 cc. and 1000 cc. respectively, or 25 and 50 ordinary doses.

A pig weighing less than 30 pounds requires only from 10 to 15 cc. of serum. The large hog requires an increased dose, depending somewhat upon his weight and condition. Ordinarily

a hog weighing 500 pounds would require at least 60 cc., and the pampered and very fat hog a larger proportionate dose.

At the present time the cost of the serum approximates somewhere in the neighborhood of one and one-half cents per cubic centimeter, at which price it is sold, making the cost per dose for the shote of 100 pounds or less 30 cents for the serum only. As the college has no funds for the production of the serum, it will be necessary to make a charge for it, at least until after the meeting of the next legislature.

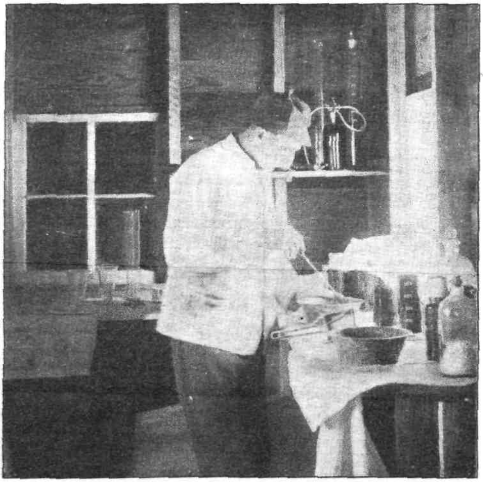

FIG. IV. Defibrinating the virulent blood. Serum laboratory.

Only the actual cost of the production will be charged, however. At this time we have not had enough experience in its manufacture to gauge accurately the cost, and the price fixed above is based on the best information we have in our own experience and on the experience of other states. Michigan charges its farmers two cents per cc., or 40 cents per average dose. Minnesota charges about the same. The Iowa legisla-

ture appropriated $8000 for the manufacture of this serum and they are charging their farmers "about 50 cents for a dose sufficient to inoculate a hog weighing 150 pounds." Ohio has three qualified veterinarians upon this work and they are selling the serum at 25 cents for an average dose.

Every economy will be practiced that is consistent with the production of serum of high protective powers and free from any foreign infection. It is hoped that it will be found possible to produce this serum at a lower cost than thirty cents for an average dose. In any case the price will be determined by the cost of production, and in no case will any profit be charged.

VACCINATING HOGS. Anti-hog-cholera serum will not cure hog cholera any more than vaccinating will cure a human being who is sick with smallpox. It is true that vaccinating may reduce the severity of the case when done in the beginning of the disease, or at the time of first exposure, but it is not expected to cure the disease. The same is true in vaccinating a hog. The serum will not cure the disease, *but it will prevent it.*

TWO METHODS OF VACCINATING. The first method is to use the serum alone. In this method there is simply injected into the muscles of the hog a dose of the anti-hog-cholera serum, which makes the hog immune against cholera for a time varying from a few weeks to several months. This is the method used when, for instance, a very fat show herd is vaccinated. It is absolutely safe.

It is also used in herds where the cholera already exists and some of the animals have been exposed only a few days. After the disease has been in a herd for three or four days, vaccinating seldom does any good. Thus the earlier the vaccination in these cases the more certain the results. A day's time here may mean either the losing or saving a large part of the herd.

Where vaccinating is done in diseased herds, the amount is increased from one-half to double the regular sized dose. The second method is one in which there is some danger, but the results, if the animal survives, renders it immune for the rest of its life. It is the so-called serum simultaneous method, in which there is injected at the same time, in addition to the serum, a small amount of virulent blood or blood taken from a hog very sick with the cholera. This method really gives the hog a very slight form of the disease and as a consequence the animal does not take the cholera the second time—it has been

artificially *immunized.* This is the most satisfactory method and is used in a healthy herd, that is, before they become infected. Great care is here necessary that too much of the virulent blood is not used; if the dose of this is too large, the form of the disease may become so severe as to make the hog quite sick with the cholera or even cause death.

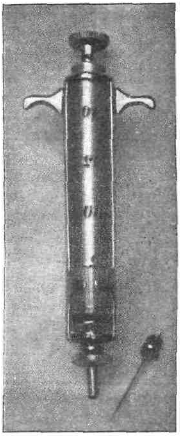

FIG. V. Hypodermic syringe, holding 20 cc., used in hyperimmunizing and vaccinating hogs.

VETERINARIANS WILL DO THE VACCINATING. On account of using the dangerous virulent blood and the ease with which these germs are spread, it has seemed advisable to have the vaccinating done, for a time at least, by graduate veterinarians, who have received proper instructions in the methods and are qualified to handle the dangerous materials. This will reduce the danger to a minimum, as in spite of the greatest care, there are at times losses from vaccinating.

AGE TO VACCINATE AND SIZE OF DOSE. The shote weighing from 30 to 100 pounds is taken as the standard size and the dose is 20 cc. of serum and 2 cc. of virulent, or infected, blood. In larger, fat or pampered hogs the dose is one-half more to double this amount, the maximum dose being 60 cc. Suckling pigs a quarter to a half less. It is always to be remembered that the younger the pigs are, the more probability there is of their outgrowing the immunity. Suckling pigs are liable to become susceptible again in the course of several months. Hogs in infected herds also receive about one-half more or a double dose, and if it helps them, they should be revaccinated in from four to six days.

IMMEDIATE EFFECTS OF VACCINATION. When the serum is potent and the work properly done the hog seldom loses a feed. The serum, however, causes a reaction and slight fever in the animal and for several days the temperature may vary several degrees, sometimes going to 106 degrees and even higher. From six to ten days after vaccinating the temperature should be back to normal again—about 103 degrees.

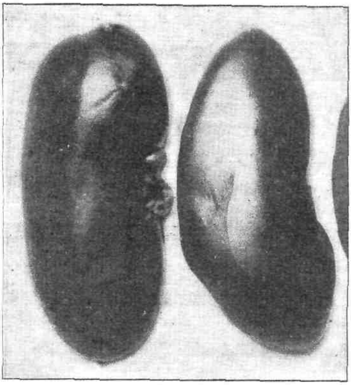

FIG. VI. Diseased kidney, showing the spotted appearance frequently found upon post mortem in hogs which have died with the cholera.

LOSSES FROM VACCINATION. The susceptibility of hogs to the disease varies greatly in different herds and even in the same herd. This was mentioned when describing the different degrees of immunity, the one condition really being the opposite of the other. At times there are a few hogs in a herd which are so susceptible to the cholera germ that no amount of serum will prevent them from dying with the disease. Again there is some danger of losses in vaccinating hogs, not alone from the fact that they might be extremely susceptible (hypersusceptible), but from the infection through the wound made by the needle. This loss all told, when the work is properly done, should not be more than from one to two per cent of the animals vaccinated in healthy herds, and frequently there are no losses whatever.

CARE OF HOGS BEFORE VACCINATING. All that is necessary before vaccinating is to cut down the rations two or three days before, feeding very little corn. Keep the animals clean and in dry and comfortable quarters, and if possible in disinfected pens. If the weather is favorable, a dipping would be all right a few days before vaccinating.

TREATMENT AFTER VACCINATING. From the fact that there is always more or less fever caused by vaccinating and more or less danger of the animal becoming infected through the wound made by the needle of the syringe, the following after-treatment would suggest itself: Spare diet for three or four days, especially of corn, but plenty of water, thoroughly clean and comfortable pens with plenty of clean bedding, with absolutely no chance to get into mud of any kind. The more mud and dirt the more danger. They should not be dipped or operated upon for at least two weeks after vaccinating.

FIG. VII. Method of drawing blood from an hyperimmunized hog. The animal is covered with a clean piece of muslin to prevent dirt from falling into the vessel with the blood.

VACCINATING INSTRUMENTS. Two hypodermic syringes are used in vaccinating. One for the serum which holds 20 cc., and one for the virulent blood holding 5 cc. The two sizes are used to prevent any mistakes being made. A thermometer is used for taking the temperatures, as we make it a rule not to use virulent blood if the temperature is high, using only the serum.

Strong antiseptics are also used to disinfect the point of injection, especially where the virulent blood is injected. If this is not done the small particles of a drop or so on the end of the needle may infect the whole premises. This is very important.

FIG. VIII. An easy way of vaccinating a light shote.

HOLDING THE HOGS WHILE VACCINATING. The pig up to the 100-pound shote is easiest handled by an attendant holding it up by the hind legs, belly forward and head held between the attendant's legs, as shown in the illustration, figure VIII. Very heavy hogs may be caught by placing a rope around the front leg or snout and held around a tree or post, or may be run into a chute or crate and vaccinated as in figure X.

FORMS OF THE DISEASE. Hog cholera is very contagious, but affects swine only, and shows itself in one of two forms, either acute or chronic. It is caused by a germ in the blood and tissues of the hog, and up to the present time has been grown nowhere else. In favorable locations it seems to live for many months. The acute form usually kills in from six to sixteen days. The chronic form is more mild and runs a slower course, the hog continuing sick for a month or more before death or recovery takes place.

CONDITIONS FAVORING THE DISEASE. Overcrowding during cold weather in the sleeping quarters, especially where different sized animals are kept in the same pen. The smaller pigs become too hot, and then very easily catch cold. Damp, filthy, dark pens where little fresh air or sunshine can reach. Sleeping in a draft under buildings or windows; a pig requires twice the breathing space for every hundred pounds of his weight that is needed by either the horse or cow. Too much green corn. Too close or inbreeding.

The accumulation of vermin on the animal itself or in the pens. Too exclusive a corn diet. The hog being frequently a scavenger, following the cattle in all kinds of mud, filth and dust, is liable to breathe the germs or irritating dust and the lungs become infected with tuberculosis or other debilitating disease germs. In fact anything that has a tendency to weaken the system of the animal renders him a more fit subject for hog cholera.

FIG. IX. Vaccinating heavy hogs.

AGE. While the disease has no respect for the age, size or breed of hogs when it once starts in a herd, it is usual for an outbreak to begin with the younger pigs and later to attack the more mature animals. But this is not always true.

SYMPTOMS. It usually starts with a diarrhœa. The pigs quit feeding, many have a cough and are dumpish for several days, lose all energy, gradually become weaker and die. The older hogs act in the same way, except that they do not usually become so thin before they die. Sometimes a constipation pre-

cedes the diarrhœa for a longer or shorter period. The discharges are usually very offensive. There is frequently a discharge from the eyes which resembles pus, which may be sticky enough to gum the lids together.

In many outbreaks one or two hogs may not feel well for several days, and before the owner is aware of the fact the whole herd may be infected and a greater or less number die every day. Some may show symptoms of a severe illness, such as fever, weakness, less of appetite, diarrhœa, redness of the skin of the abdomen or flanks and in patches around the snout or ears· while others may show but a few of these symptoms before death.

CONDITIONS OR DISEASES WHICH RESEMBLE CHOLERA. Some conditions or diseases which resemble cholera are tuberculosis, although this disease is usually much slower in its progress; ordinary digestive troubles, due to improper feeding or unsanitary surroundings; anthrax; pneumonia, caused by dust, cold or worms. Garbage which contains much soap, lye or salt will frequently cause death with symptoms resembling cholera. Moldy bread, cottonseed meal, new corn, or too sudden changes of feed. Many things which are unfit for human food, are thrown into the swill barrel, to form toxins and ptomains. These may cause vomiting, bloody diarrhœa, griping, nervous troubles, weakness, staggering gait, dullness, and death, all of which are laid to cholera.

SEASON OF THE YEAR. Hog cholera is most prevalent in the fall of the year and early winter. During the cold weather the cases, as a rule, become more chronic, do not die so suddenly, and a greater per cent of them get well.

MANNER OF INFECTION. This being a contagious disease, it follows that the germ of cholera must be carried into a herd before they can contract the disease. It is distributed somewhat on the same plan as are those of typhoid fever, scarlet fever or diphtheria in the human race. The germs are present in the blood and tissue of the affected animals, and are thrown off through every avenue of the body, especially through the urine and feces. In this way they infect the whole yard in which the hogs are kept, and also everything in the yard and pens. The smallest particle of dirt—so small that it cannot be seen, will carry enough germs to infect several herds of hogs. It is thus apparent that a stranger should not be allowed

near the pens of sick hogs; neither should the attendant be allowed to leave the vicinity of the pens without first thoroughly cleaning and disinfecting his shoes or putting on others not infected. Dogs, cats, rats, crows and other birds—in fact, every living thing—should so far as possible be kept away from the infected places.

FIG. X. Heavy hog snubbed up close to a post and held for vaccinating.

Several years ago the writer had occasion to observe a number of outbreaks of cholera in different parts of the state, and found that the number of infected herds and losses along a stream of water were in some instances over fifty per cent greater than were found in herds two miles back from the stream. In several of these places hogs were found aboveground that had been dead from the cholera for four or five days and the rains washing the germs down the stream constantly.

PUBLIC STOCKYARDS. It seems that we must consider all

public stockyards infected with cholera. Persons walking from these public yards to the depot platforms naturally infect these places. It is in this way that a crated breeding hog, for instance, shipped by freight or express, becomes exposed to the disease and may infect the whole premises when released from the crate. It is therefore not safe to take a hog upon the public highway even, especially if there has been cholera anywhere in the vicinity. In the fall of the year, during severe dust storms, the germs may be blown a considerable distance with infected straw, weeds, etc.

FIG. XI. Method of vaccinating a sow heavy in pig.

PERIOD OF INCUBATION. The time required for a hog to become sick with cholera after being exposed to the disease varies usually from six to fourteen days, but sometimes runs much longer.

PREVENTION OF THE DISEASE. When we recall the conditions which favor the disease and the manner in which the infection takes place, it will be seen that the feeding and care of

hogs have much to do with the prevention of the cholera. Clean, dry pens, regular and proper feeding, comfortable sleeping quarters, plenty of sunshine, the pens cleaned and disinfected regularly, the hogs themselves dipped every few weeks when the weather is fit, all help in keeping up their vitality, and in this way warding off troubles of all kinds. Many hog raisers feed at regular intervals some of the following mixture to aid digestion and circulation and to prevent worms, especially where the animals are confined to a small lot:

Wood charcoal, powdered	1 lb.
Sulphur	1 "
Sodium chloride	2 "
Sodium bicarbonate	2 "
Sodium sulphate	2 "
Sodium hyposulphite	1 "
Antimony sulphide (black antimony)	1 "

This is the formula as published by the Bureau of Animal Industry some years ago. The dose of this mixture is one large tablespoonful to each 200 pounds of hog once per day.

After shipping a hog it should be dipped as soon as removed from the crate and kept away from all others for several weeks, and then dipped again before being allowed to come in contact with the rest. If a hog shows signs of sickness it should be at once removed and kept by itself until well.

In September, 1909, a breeder of high-class hogs, living several miles from the college, noticed three head sick, one almost dead. A *post-mortem* was held by members of the Veterinary Department of the college and the disease diagnosed as acute cholera. The remaining hogs were thoroughly dipped and removed to new, clean quarters and everything disinfected, and no further cases developed. Prompt, vigorous methods in this case saved the herd.

DISINFECTION. All straw, cobs and litter should be removed and, if cholera is present, burned, and a strong solution of some good coal-tar dip or crude carbolic acid, about one part of the dip to twenty of water, used on all woodwork and floor of the pens; slaked lime scattered over the ground and floors of the pens every few days will help to keep them clean.

POST-MORTEMS. Care should be taken to prevent blood poisoning of the operator as a result of the *post-mortem* of any

animal. If a person has any sore on his hand he should not touch a dead animal, or if he should receive a cut or scratch during the examination the hand should be placed in pure kerosene at once, the sore well filled and the bandage saturated with it.

FIG. XII. Bleeding a pig about to die with the cholera. The defibrinated blood will be used either for hyperimmunizing or for vaccinating healthy hogs.

When a hog has died quickly within a few days after taking the disease, the kidneys frequently show dark spots on their surface, as shown in the illustration (fig. VI). These resemble the spots on a turkey egg. Parts of the lungs may be found

solid and dark, resembling liver, or may show dark spots on their surface like those on the kidneys. The spleen is usually larger than normal. The lymphatic glands, especially those along the intestines, are usually enlarged and red. The intestine may contain blood or bloody feces.

In chronic cases, in which the hog lingers for a longer period before death, some of the above conditions show prominently while others do not show so well. In these cases ulcers are found on the inner lining of the large intestine, which may be an inch in diameter, or there may be many smaller ones, but as a rule, these do not show so well in the more acute forms of the disease. It seldom happens that all these conditions are found in the same animal, but any two of them are usually enough to warrant the diagnosis of hog cholera, and when the ulcers in the intestines are found they are positive evidence that it is cholera.